Terrestrial Species Assessments
Region 6 Forest Plan Revisions
August 2010

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Terrestrial Species Viability Assessments
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INTRODUCTION

This document provides Regional guidance on how to conduct terrestrial species viability assessments when National Forest plans are revised in Region 6. Currently this direction has been developed only for the Forests east of the Cascades. This is due to the regional revision schedule where east-side forest plans are being revised first.

The National Forest Management Act (NFMA) requires land management plans to provide for diversity of plant and animal communities based on the suitability and capability of the land area while meeting overall multiple-use objectives. A hierarchical approach that analyzes ecosystem diversity and species diversity is used in the Regional guidance.

The Regional guidance was developed by a team of biologists from the Washington, Regional, and National Forest offices in cooperation with a science team from the Pacific Northwest Research Station (Appendix B). The purpose of the Regional guidance is to improve efficiencies in the assessment process, reduce costs by reducing redundancy in analyses, provide a forum for a rigorous science review of the process, and provides consistency across the Region as National Forests or groups of National Forests revise their plans.

The initial focus of the assessment process will be on ecosystem diversity, both in addressing the needs of healthy, diverse, and resilient native ecosystems within the plan area, and in determining the extent to which maintaining ecosystem diversity will provide for viable populations of plant and animal species within their ranges in the plan area. This has often been referred to as a "coarse filter" conservation approach (Hunter et al. 1988, Landres et al. 1999, Samson 2002, Samson et al. 2003). The coarse filter ecosystem diversity evaluation generally compares existing vegetation communities to a set of reference conditions (pre-settlement, range of variability, etc.) in order to evaluate changes in disturbance regimes and as a check on adequate representation of ecological communities (Samson 2002). For National Forests located within the Interior Columbia Basin, these broad-scale assessments were completed as part of the Interior Columbia Basin Ecosystem Management Project (ICBEMP) and included evaluations of existing plant communities compared to historic reference conditions (Hann et al. 1997, Hessburg et al. 1999) and an evaluation of changes that have occurred in the availability, effectiveness, and connectivity of habitats for focal species (Lehmkuhl et al. 1997, Wisdom et al. 2000, Raphael et al. 2001). At the conclusion of ICBEMP, an Interior Columbia Basin Strategy was developed to ensure that the science and knowledge gained from ICBEMP assessments would be used in the revision of land and resource management plans. The ICBEMP assessments provide information and context important for assessing species diversity at the scale of the Forest plan area and are an important element of the Interior Columbia Basin Strategy.

Ecosystem diversity is evaluated by identifying key ecosystem characteristics, assessing natural variation under disturbance regimes, and comparing results to existing and future conditions. This information can then be used to help develop plan options during the revision process and plan components such as desired conditions, objectives, and suitability determinations.

A complementary approach to coarse filter analysis is necessary for those species for which ecological conditions necessary to sustain populations may not be provided by maintaining ecosystem diversity. In these cases, a species-specific approach to the analysis and establishment of plan direction may be necessary. The assessment of individual species is often referred to as the "fine-filter" conservation approach (Holthausen et al. 1999, Holthausen 2002, Andelman et al. 2001, Samson et al. 2003). Holthausen (2002) and Andelman et al. (2001) provide valuable suggestions on how to assess species diversity.

Terrestrial Species Assessment Process Overview

Based primarily on Holthausen (2002), and tiering to ICBEMP science (Wisdom et al. 2000, Raphael et al. 2001), a detailed process was developed to guide terrestrial species assessments. Regional guidance will be issued in two phases. Phase I has been completed. Phase II is undergoing development and testing as the first revision forests in the Region apply models and conduct analyses. Phase II of Regional guidance will be issued subsequent to testing and modifications. The Regional guidance follows these basic steps:

Phase I

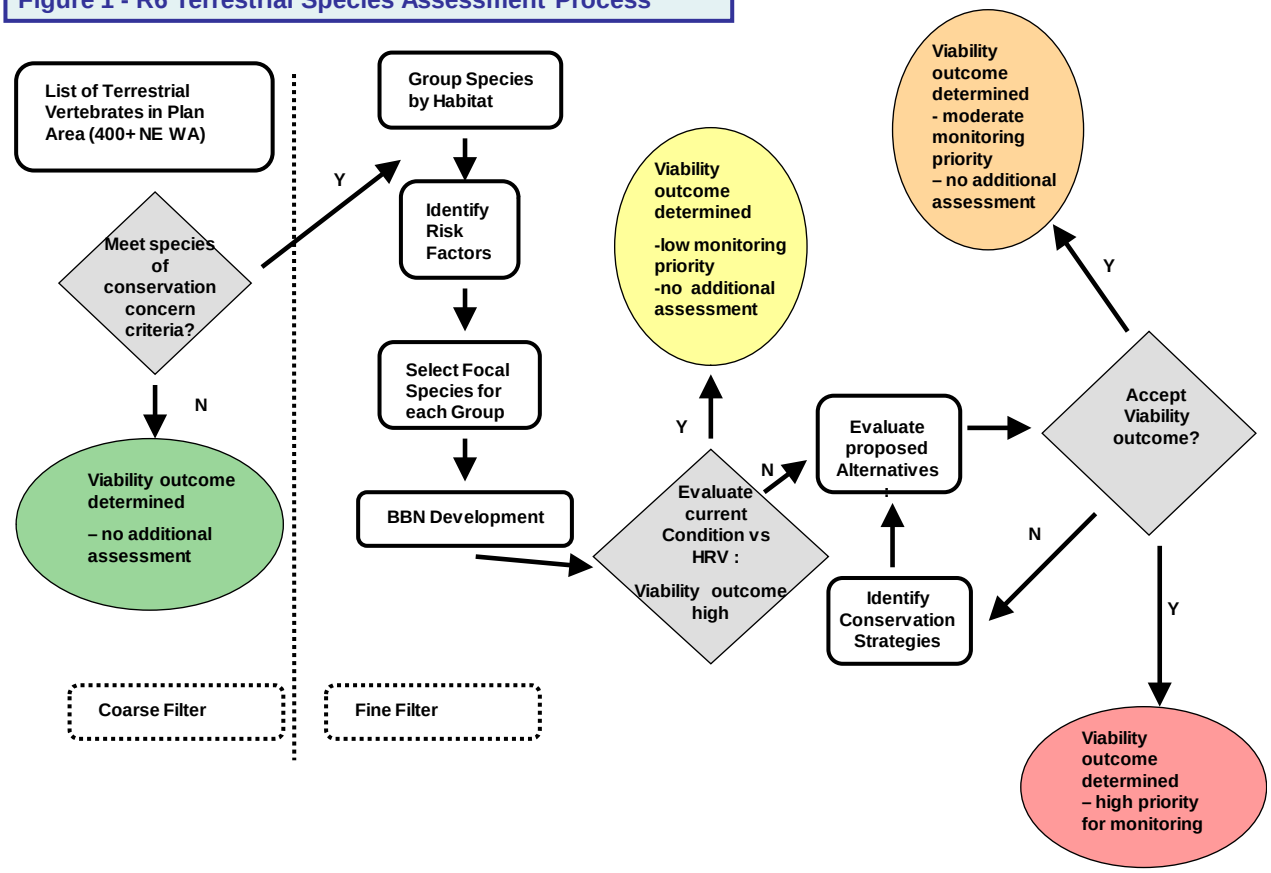
- Identification of Species of Conservation Concern
- Defining Source Habitats for Species of Conservation Concern
- Grouping Species of Conservation Concern
- Description of Ecological Relationships of Species of Conservation Concern
- Selection of Focal Species

Phase II

- Development of Focal species assessment models
- Development of Conservation Strategies
- Monitoring and Adaptive Management

The rationale for this process is further described below. Figure 1 outlines the general assessment process.

Figure 1 - R6 Terrestrial Species Assessment Process



Identifying Species of Conservation Concern

Species of conservation concern are species for which the Responsible Official determines that analysis at the plan scale is warranted to determine if management actions may be necessary to provide for viable populations in the planning area.

Species were selected for assessment using various sources of information which indicate species that have conservation concerns, including Heritage protocols. Andelman et al. (2004) recommended the Heritage global ranks as a system that would be appropriate for use by the Forest Service to meet the NFMA requirement for diversity. They recommend the Heritage protocols because many of the species occurring on National Forest lands have been ranked, the database is readily available, and the state and global ranks may be the most suitable of existing protocols for identifying species of concern. However, they suggest that the initial protocol used to rank species (Master 1991, Master et al. 2000) did not explicitly incorporate weightings for threats. Because of this, the Regional guidance process includes risk factors for each species that can be used to evaluate how management activities can influence speciesviability.

Also incorporated were the Partners in Flight rankings (Carter et al. 2000) and two additional broad-scale viability analyses that were completed as part of the ICBEMP assessments (Lehmkuhl et al. 1997, Raphael et al. 2001, Wisdom et al. 2000). Once the species were selected, it was necessary to create a subset of species upon which to focus assessment and conservation efforts. One approach to this is the focal species concept (Lambeck 1997).

Defining Source Habitats for Species of Conservation Concern

The definition of source habitat was used from Wisdom et al. (2000) which are those characteristics of macro-vegetation that contribute to stationary or positive population growth. Source habitats are distinguished from habitats simply associated with species occurrence; associated habitats may or may not contribute to long-term population persistence (Wisdom et al. 2000).

Grouping Species of Conservation Concern

While managing species habitats and populations using a species-by-species approach has intuitive ecological merit, the sheer number of species of conservation concern often makes such an approach untenable. In many cases, the ecological understanding and resources needed to manage all species on an individual basis are not available. More importantly, attempting to manage for species of conservation concern on an individual basis may not result in holistic management of all species' needs because management focus is often fine-scale, piecemeal, and without explicit understanding of the commonalities and differences in species needs among large sets of species.

Tremendous efficiencies can be gained from managing groups of species. The idea that efficiency can be gained, while maintaining effectiveness in accounting for all species needs, is a central premise to grouping approaches (Van Horne and Wiens 1991). Grouping species based on one or more ecological factors provides a strong

foundation for developing conservation strategies for species of conservation concern, because the conservation strategies can then be ordered around ecological principles.

Description of Ecological Relationships of Species of Conservation Concern

To more thoroughly understand the ecological requirements of the species of conservation concern, it was necessary to review other information beyond source habitats for each species. Besides focusing on habitats that are key to population growth of species, it is acknowledged that factors beyond macro-vegetation can affect population persistence. Additional information on risk factors, fine scale habitat features, home-range size, and species ranges for each species of conservation concern should be considered (Andelman et al. 2001).

Focal Species Approach

Species were grouped to facilitate viability assessments, similar to the way they were grouped for ICBEMP assessments (Wisdom et al. 2000, Raphael et al. 2001). Species groups are defined by having similar habitat requirements. A species selected from the group becomes the species upon which the assessment is focused. The focal species approach is an attempt to streamline the assessment of ecological systems by monitoring a subset of species and can be seen as a pragmatic response to dealing with ecosystem complexity (Noon 2003, Roberge and Angelstam 2004). The key characteristic of a focal species is that its status and trend provide insights to the integrity of the larger ecological system to which it belongs (Lambeck 1997, Noss et al. 1997, Andelman et al. 2001, Noon 2003). Focal species serve an umbrella function in terms of encompassing habitats needed for other species, are sensitive to the changes likely to occur in the area, or otherwise serve as an indicator of ecological sustainability (Lambeck 1997, Noss et al. 1997, COS 1999, Andelman et al. 2001). The viability of the focal species is assumed representative of a group of species with similar ecological requirements and this group is assumed to respond in a similar manner to environmental change. In addition, the focal species is assumed to have more demanding requirements for factors putting other group members at risk of extinction (Andelman et al. 2001). In this analysis, focal species are intended to represent ecological conditions that provide for viability of other species in the group. Focal species represent the species group in that, providing for adequate amounts and distribution of habitat and managing risks for focal species provide the ecological conditions needed to maintain viability of other associated species.

Lindenmayer et al. (2002) pointed out some of the limitations of the focal species concept, including that the approach is data-intensive, that scientific understanding is lacking for many species, and there is a lack of testing to validate the approach. Lindenmayer et al. (2002) were concerned that the focal species approach not be the only approach used to guide landscape restoration. However, the focal species approach has recently been tested for some wide-ranging carnivores (Carroll et al. 2001) and birds (Watson et al. 2001) with promising results. In addition, Roberge and Angelstam (2004) recently reviewed the umbrella species concept and concluded that the focal species approach seems the most promising because it provides a systematic procedure for selection of umbrella species. The focal species approach described here is designed to complement an ecosystem diversity assessment that would be

completed before or in conjunction with the species viability assessment. The focal species approach is a relatively rigorous way, compared to other approaches, to deal with assessments that involve large numbers of species (Adelman et al. 2001, Roberge and Angelstam 2004).

Development of Focal Species Assessment Models

Assessing the viability of each focal species requires the development of credible and repeatable analysis processes. One way this was accomplished in the ICBEMP was using Bayesian Belief Networks (BBNs) (Marcot et al. 2001, Raphael et al. 2001, Rieman et al. 2001). The use of Bayesian statistics, specifically BBNs, is one way to combine scientific data and information with expert knowledge and experience (Lehmkuhl et al. 2001, Marcot et al. 2001, Wade et al. 2002). This is especially important when trying to assess a multitude of species, many of which have little or no available empirical data. A BBN is an influence diagram, which depicts the relationships among ecological factors (such as habitat and risks) that influence the likelihood of the outcome of some parameter(s) of interest, such as forest condition or wildlife species viability (Marcot et al. 2001). This approach provides a conceptual model outlining the interconnections among ecosystem components and how a species is anticipated to respond to the risk factors. This represents an important step in the application of the focal species approach intended to provide insights into ecosystem processes and functions (Noon 2003, Ogden et al. 2003).

Benefits of using a BBN modeling approach include (Marcot et al. 2001, Raphael et al. 2001):

- Major influences on population persistence and/or quality of habitat can be displayed.
- Linkages between features of a proposed management action and the predicted response of a species can be represented.
- Empirical data and expert judgment can be combined.
- Models may be easily re-run with different management actions or new model assumptions.
- Predicted outcomes are based on probabilities.
- Model results include measures of uncertainty and sources of variation.
- Model results are spatially explicit.

Development of Conservation Strategies

Species assessments should be used in the development of management approaches and options in plan revisions. Results from analyses can be used in an iterative manner to identify habitat restoration and conservation strategies or measures needed to maintain species diversity. These strategies or measures should be reflected in plan components such as desired conditions, objectives, and suitability.

Monitoring and Adaptive Management

When dealing with complex management questions and high levels of uncertainty, monitoring and adaptive management become vital tools (Busch and Trexler 2003, Christensen et al. 1996, Christensen 1997, Everett et al. 1994, Gaines et al. 2003a). Assessing the viability of species is complex and involves uncertainties. Key assumptions used in the development of the Regional guidance process include:

- Species' viability models provide a conceptual outline of the primary habitat and risk factors that influence the viabilitiy of focal species.

- The assessment models provide a reasonable and scientifically credible structural approximation of the species niche in the ecosystem that can be used to identify key monitoring elements.

- Focal species represent the species group in a manner that provides insights into the capability of the habitat to support other species associated with the group.

These assumptions guide development of specific monitoring and research questions that vary for each focal species. Because of the number of focal species selected to represent various habitats and risk factors, it is not possible to monitor all focal species in a rigorous manner due to cost and impracticality. Therefore, a process was developed to prioritize focal species monitoring based on the following:

- An assessment of focal species viability.

- Whether the risk factors that influence species' viability are likely to increase, decrease or remain the same based on proposed management options.

- The degree of uncertainty associated with the ability to predict the relationship between focal species and associated risk factors.

Regional Guidance and Plan Revisions

Much will be learned from testing the Regional guidance in plan revisions of the Northeast Washington National Forests. It is expected that the guidance will be modified through time as new information and insights are acquired. By staging plan revisions over time, it is expected that Forests finishing plan revisions will share knowledge and experience gained with Forests beginning plan revisions. This would include how to interpret the species assessments in support of project planning.

METHODS-PHASE I

Identification of Species of Conservation Concern

The focus in this process is on species that are of regional or local conservation concern as indicated by documented threats to populations or habitats. Native terrestrial vertebrates and invertebrates known to occur on land managed by the USDA Forest Service on the east side of the crest of the Cascade Mountains in Washington or Oregon were considered. Accidental species are not included or extirpated species without near-term plans or opportunities for reintroduction.

R6 developed screening criteria that included information from the U.S. Fish and Wildlife Service, state fish and wildlife agencies as well as other published species ranking programs in developing a list of species of conservation concern.

Regional Criteria
Specifically, Region 6 species of conservation concern for the eastside of the Cascade Mountains include species that meet the following criteria:

- Species listed as endangered or threatened under the U.S. Endangered Species Act (ESA).
- Species identified as candidate and proposed species under ESA.
- Species with ranks of G-1 through G-3 on the NatureServe ranking system.
- Infraspecific (subspecific) taxa with ranks of T-1 through T-3 on NatureServe.
- Species that have been petitioned for Federal listing under ESA and for which a positive “90 day finding” has been made.
- Species with ranks of S-1 through S-3 on the NatureServe ranking system (this includes species listed as Sensitive by the Pacific Northwest Region Forest Service).
- Species listed by Oregon Department of Fish and Wildlife or Washington Department of Fish and Wildlife as threatened or endangered.
- Bird species on the U.S. Fish and Wildlife Service Birds of Conservation Concern National Priority list (U.S. Fish and Wildlife Service 2002).
- Additional species that valid, existing information indicates are of regional or local conservation concern due to factors that may include significant threats to populations or habitat, declining trends in populations or habitat, rarity, or restricted ranges (for example, narrow endemics, disjunct populations, or species at the edge of their range). The following was used to meet this criteria:
    - Bird species in the Partners in Flight (PIF) Species Assessment Database (http://www.rmbo.org/pif/pifdb.html) with scores indicating a moderate to large population decline or severe to extreme threats to populations.
    - Species listed by the States of Oregon or Washington as Strategy Species in their Comprehensive Wildlife Conservation Strategies.
    - Species identified as a ‘terrestrial vertebrate species of focus by Wisdom et al. (2000) that occur on National Forest System lands in the Pacific

Northwest Region. This list consists of 173 species identified from the Interior Columbia Basin Ecosystem Management Project and was primarily based on Lehmkuhl et al. (1997). Species were included from that list **unless** they met one or more of the following criteria:

- Wisdom et al. (2000) concluded a positive or neutral change in source habitats in the Ecological Reporting Units overlapping Oregon and Washington and there was no other published reason for concern found.
- If more recent analysis of populations (e.g., breeding bird survey data), or expert opinion was available that indicated there was not currently a reason for concern.

- Species with a population outcome of D or E under the current condition scenario, or outcome C with a decline from a historical outcome of A or B (Environmental Outcome for FS/BLM lands) as defined in Raphael et al. (2001).

Appendix A lists species for both the Blue Mountain and Northeast Washington planning areas. It is expected that each planning area undergoing plan revision will use both the Appendix and the Regional criteria to update the species list as needed for their planning area.

Defining Source Habitats for Species of Conservation Concern

Classification of Vegetation

Vegetation for the eastside of Oregon and Washington was classified using a combination of cover types and structural classes similar to those described in Johnson and O'Neil (2001). Some of the Johnson and O'Neil classes were combined to better match the vegetation classification available for Forest Plan revisions. A post-fire cover type was identified to address vegetation that occurs immediately following a stand-replacing fire because some species of conservation concern are associated with this vegetation community. Six types of riparian habitat were also described. **Tables 2 and 3** display the community types and structural stages used for assigning species to source habitats.

Table 1. Vegetation community types used to assign species to source habitats.

R6 Community Type	Habitat Types (Johnson and O'Neil)
Open water	Open Water
Marsh	Herbaceous Wetlands
Wet Meadow	Herbaceous Wetlands
Coniferous Riparian	Montane Coniferous Wetlands Eastside (Interior) Riparian Wetlands
Deciduous Riparian/ Shrub Wetland	Montane Coniferous Wetlands Eastside (Interior) Riparian Wetlands

Alpine	Alpine Grassland and Shrublands
Grasslands	Eastside (Interior) Grasslands
Shrublands	Eastside (Interior) Canyon Shrublands Shrub-Steppe Dwarf Shrub-Steppe Desert Playa and Salt Scrub Shrublands
Juniper Woodlands	Western Juniper and Mountain Mahogany Woodlands
Montane Mixed Conifer Forest	Montane Mixed Conifer Forest
Eastside Mixed Conifer Forest	Eastside (Interior) Mixed Conifer Forest
Lodgepole Pine Forest	Lodgepole Pine Forest and Woodlands
Ponderosa Pine Forest	Ponderosa Pine and Eastside White-Oak Forest and Woodlands
Subalpine	Subalpine Parkland

Table 2. Vegetation structural stages used in the assignment of species to source habitats.

R6 structural stage	Canopy cover[1]	Canopy layers	Definition of structure stage	Johnson and O'Neil (2001) Structural Condition Classes
Grass/Forb	Open	single	Herbaceous seral stage in forested habitats	Grass/Forb – Open Grass/Forb – Closed
Post-fire	Open	single	First 10 years post stand-replacing fire, abundant standing dead trees	None
Sapling	Open or closed	single	Earlier seral stages in forested habitats From shrub stage through closed forest of trees < 10" dbh	Shrub/Seedling – Open Shrub/Seedling – Closed Sapling/Pole – Open Sapling/Pole – Moderate Sapling/Pole - Closed
Small Tree – Open	Open	Single or multi	Primarily mid-seral stages May be later-seral on harsher sites Forested stages with trees 10 to 15" dbh Canopy closure is < 50%	Small Tree – Single Story – Open Small Tree – Single Story – Moderate Small Tree – Multi-story – Open Small Tree – Multi-story – Moderate
Small Tree – Closed	Closed	Single or multi	Primarily mid-seral stages May be later-seral on	Small Tree – Single Story – Moderate

			harsher sites Forested stages with trees 10 to 15” dbh Canopy closure is > 50%	Small Tree – Single Story – Closed Small Tree – Multi-story – Moderate Small Tree – Multi-story – Closed
Medium Tree –Open	Open	Single or multi	Usually mid- to late-seral stages Forested stages with trees 15 to 20” dbh Canopy closure is < 50%	Medium Tree – Single Story – Open Medium Tree – Single Story – Moderate Medium Tree – Multi-story – Open Medium Tree – Multi-story – Moderate
Medium Tree –– Closed	Closed	Single or multi	Usually mid- to late-seral stages Forested stages with trees 15 to 20” dbh Canopy closure is > 50%	Medium Tree – Single Story – Moderate Medium Tree – Single Story – Closed Medium Tree – Multi-story – Moderate Medium Tree – Multi-story – Closed
Large Tree – Open	Open	Single or multi	Usually late-seral stages Forested stages with trees > 20” dbh Canopy closure is < 50%	Large Tree – Single Story – Open Large Tree – Single Story – Moderate Large Tree – Multi-story – Open Large Tree – Multi-story – Moderate Giant Tree – Multi-story
Large Tree – Closed	Closed	Single or multi	Usually late-seral stages Forested stages with trees > 20” dbh Canopy closure is > 50%	Large Tree – Single Story – Moderate Large Tree – Single Story – Closed Large Tree – Multi-story – Moderate Large Tree – Multi-story – Closed Giant Tree – Multi-story

[1]A 50% canopy closure break was used to divide open from closed canopy, which is between the 30 and 70% range that defines “moderate” canopy closure in Johnson and O’Neil (2001)

Structural condition classes were described only for upland forested habitats. The 26 classes of Johnson and O’Neil (2001) were lumped into 12 for this process. After a literature review of habitat relationships for wildlife species of conservation concern, two canopy closure breaks, open (<50%) and closed (>50%) were identified rather than the three classes described by Johnson and O’Neil (2001), to better meet the objectives of this process.

Defining Source Habitats for Species of Conservation Concern

The macro-habitats used by each of the species were described using cover type and structural stage. Habitats included are those used for reproduction, movement, and cover (e.g., protection, thermoregulation) although they were not documented separately. The species habitat relationship database from Johnson and O'Neil (2001), the source habitat database from the ICBEMP (Wisdom et al. 2000), literature, and professional judgment were used to identify source habitats for each species of conservation concern. For each species the combination of each cover type/ structural stage was identified either as source habitat or as not source habitat.

Grouping Species of Conservation Concern

In this process species groups were based on habitat associations using cover type and structural stage, as in Wisdom et al. (2000) and suggested by Forest Service planning directives. A cluster analysis was performed to convey species and habitat associations. In the cluster analysis, 51 habitat variables were used consisting of seven land cover types, five tree size classes, and two canopy closure categories for forested vegetation; three non-forest land cover types; five riparian/water land cover types; and a cave category.

Based upon knowledge of ecological relationships of the species evaluated, the smallest number of groups possible was chosen that still allowed a meaningful aggregation of species and habitats that reflected important patterns in source habitats. Groups were then aggregated into families to help describe how similar groups of species are related to each other. Families include one or more groups that are associated with similar broad scale vegetative conditions. These generalized vegetative conditions are often used by managers to interpret broad scale patterns and trends. By using a hierarchical evaluation of species, groups, and families, the analysis process addresses single- and multi-species needs as well as identifies broad-scale patterns of habitat change, as did Wisdom et al. (2000).

Appendix A displays the results of grouping species.

Description of Ecological Relationships of Species of Conservation Concern

Risk-factors

Through literature review, risk factors were identified for all wildlife species of conservation concern that had a potential reduction in: 1) habitat availability; 2) habitat effectiveness, and/or; 3) population size and/or fitness.

The identification of risk factors was initially based on literature reviews conducted by Wisdom et al. (2000) and Singleton and Lehmkuhl (1998) to address road-related factors, and Gaines et al. (2003b) to address recreation-related factors. These reviews were expanded to include risk factors associated with the management of vegetation, fire, grazing, and invasive species.

Fine-scale habitats
Macrohabitat association information captures broad-scale habitat use by a species. In addition to broad-scale habitats, it was noted whether a species uses specific fine-scale habitats such as water features (e.g., springs and seeps), topographic features (e.g., talus slopes), within-stand features (e.g., logs, decayed trees), or other physical features (e.g., serpentine soil) from Johnson and O'Neill (2001).

Home range and dispersal information
Both the typical home range used by a species, and its dispersal capabilities, may play a role in determining which species may best represent ecological requirements of other species. Johnson and O'Neil (2001) were used for this information.

Species range across the planning area
Range information is helpful in determining which species may best represent the ecological requirements of other species across the planning area (e.g., species with non-overlapping ranges will poorly represent each other's requirements).

Selection of Focal Species

The goal for the Regional guidance process was to have a manageable number of focal species to assess while still maintaining a reliable inference for providing appropriate ecological conditions for non-focal species. After species were clustered into groups based on habitat relationships and other environmental requirements, a single or small set of focal species was identified within each group. The intent was to select a set of species that represented the full array of potential responses of species to management activities (Raphael et al. 2001). The criteria below were used to select focal species:

- Source habitats: In some cases, if there are important differences in source habitat use within a species group, multiple focal species may be needed to represent the full array of source habitats used by the group.
- Risk factors: Species were selected that represented all or key combinations of risk factors identified for the group or family.
- Fine scale habitats: Species were selected that use all fine scale habitat features identified for the group or family. For example, if some species within the habitat-based group use snags, then a species with the most demanding or limiting snag requirements was selected as a focal species.
- Home range and dispersal information: Lambeck (1997) recommended that species with the most demanding requirements be selected as focal species. An attempt was made to choose species with the largest home range, which is a more limiting

requirement than smaller home range species. Knowledge of dispersal capabilities was lacking for most species, though where possible, species with the most limited dispersal capability were considered as a focal species.

- Species range across the planning area: Species with the widest distribution across the planning area were given priority in the selection of focal species.

Four types of focal species were identified:

1. **F** Indicates focal species for the group. In some cases these species are also acting as a focal species for others in the family.
2. **F*** Indicates a choice of focal species depending on the individual planning unit. Primarily due to species distribution issues, planning areas may choose different species.
3. **f** Indicates species having very localized populations confined to specific habitats. These species may be chosen as focal species and will need to be analyzed locally where they occur. Proposed management direction will apply only to that local area.
4. **CS** Indicates a Conservation Strategy or Recovery Plan is in place, primarily by the US Fish and Wildlife Service. In some cases, the conservation strategy will encompass the range of other species in the group and perhaps family, and therefore other species in this group and family with similar source habitats and risk factors will benefit from the conservation strategy.

Appendix A displays species of conservation concern and their status, family, group, and focal identification for R6 eastside Forests. Background data and information on risk factors, source habitat identification, species range, and other information is documented in file records in the Regional Office.

METHODS-PHASE II

Development of Focal Species Assessment models

Focal Species Assessment models using Bayesian Belief Network (BBN) approach for focal species are currently being developed and tested as the first National Forests undergo plan revisions. The following describes an approach currently being used to test the models in the analysis process. This approach may be revised after the initial testing on the Northeast Washington Forests has been completed. Any changes to the process described will be issued in subsequent Regional guidance. In those situations where data is not available to analyze a focal species through a BBN approach, an alternative analysis approach will be used.

Assessment models were developed to assess current ecological conditions and the response of focal species to changes in habitat conditions resulting from proposed management actions. The BBN approach provide a structured tool for integrating

several sources of information to make comparisons among management alternatives on how well the conservation of focal species is addressed (Marcot et al. 2001).

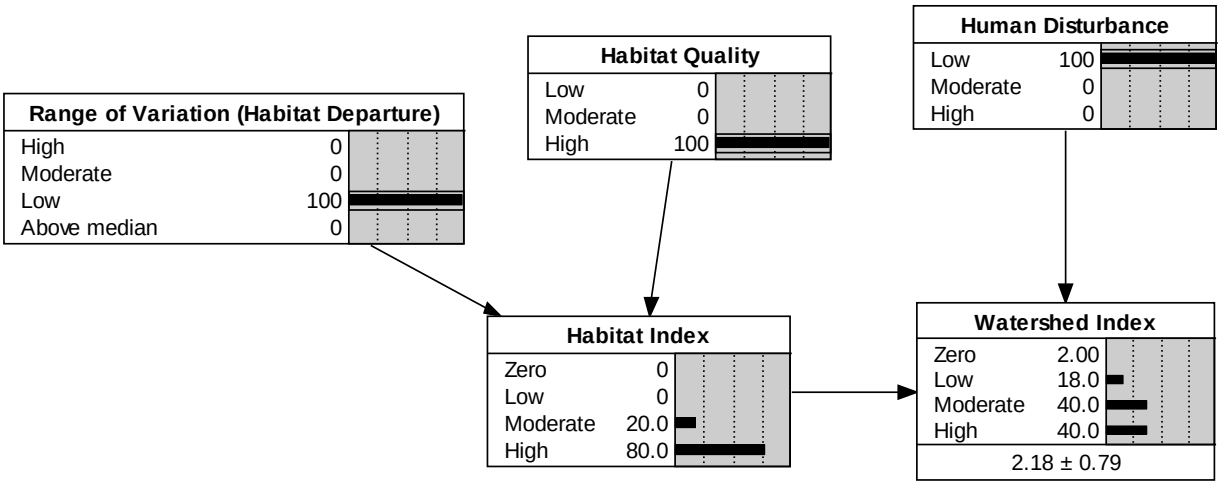
Once the BBN modeling framework was established, a method for objectively assessing the quality and quantity of habitat available for focal species was chosen. Planning directives suggest using the natural variation of ecosystem characteristics (such as the amount of habitat) under historic disturbance regimes (FSH 1909.12). Natural variability refers to the composition, structure, and dynamics of ecosystems before settlement (Morgan et al. 1994, Swanson et al. 1994, Fule' et al. 1997, Landres et al. 1999). By comparing the current condition of source habitats with the range of variability together with an analysis of risk factors, insights were gained into the capability of each Hydrologic Unit Code (HUC) 5 to provide habitat that would contribute to the sustainability of focal species (Wisdom et al. 2000). This additionally provides an objective measure of habitat sustainability and allows habitat restoration opportunities to be identified (Society for Ecological Restoration 1993, Gaines 2000, Wisdom et al. 2000).

Two models were developed for each species analyzed, similar to the approach used in Wisdom et al. (2000). The first calculation provided a measure of change from historical conditions to current conditions for each watershed (HUC 5) in the planning area and was referred to as the Watershed Index (WI). The second model calculated an overall index of the potential capability of the planning area to provide for viability of the focal species. This is the Viability Index (VI) model that uses the aggregated data from the Watershed Index models and for some species, an assessment of how well habitats are connected across the planning area.

Watershed Index Models

Databases of life history traits were developed for each focal species based on literature reviews and expert opinion in order to develop models for assessing focal species viability. Two types of watershed index models were developed. The first type, the Watershed Index (WI) model, compares a current estimate of source habitat with an estimate of the historical amount of habitat in order to assess how habitat quantity may have changed for each focal species. The WI models also incorporate information that influences the quality of the source habitat such as patch size, connectivity, and fine scale features such as snags and downed logs. The second type of watershed model, the Weighted Watershed Index (WWI) takes the score from the WI and weights it by the amount of source habitat currently available in each watershed. The WWI provides a measure of the potential capability of the watershed to contribute to the viability of the focal species. **Figure 2** displays the primary variables used in the BBN models.

Figure 2: Basic Structure Watershed Index Model



The primary variables used in the Watershed Index model include:

Range of Variability (RV) for Source Habitat*:* The RV for source habitat was estimated from the literature (e.g., Hessburg et al. 1999, Agee 2003) in order to assess the capability of the watershed to provide source habitats for focal species. The current condition of source habitat within each watershed (HUC 5) for a focal species was compared to an estimate of the range of variability for that species' source habitat.

Source Habitat Current: *S*patial data files of source habitat for each focal species were developed for the planning area based on source habitat definitions, cover types, and structural classes.

Habitat quality factors: For many focal species, the quality of source habitat was assessed based on information such as the density of snags and logs, patch size of source habitat, or the connectivity of source habitat.

Other risk factors: Risk factors attributed to human activities were identified from literature review or species experts. The influence of these factors on focal species viability was assessed for each HUC 5 by measuring or indexing the spatial extent of their effects to source habitats. These included measures such as road density, distribution of recreation routes or facilities, human population densities, etc.

Viability Index Models

The Viability Index (VI) models that were developed for each focal species incorporate information from the watershed index scores, distribution of source habitats across the planning area, and for some species, how well habitats were connected across watersheds. TheVI should be thought of as a large-scale index of the capability of the environment to support population abundance and distribution. It is assumed that species with high VI scores would have a high probability of having populations that are

self-sustaining, and well distributed throughout their historical ranges in the planning area.

Environmental outcomes defined in Raphael et al. (2001) were used as a basis to describe five viability outcomes. These outcomes were calculated for current and historical conditions for each focal species to assess changes in habitat conditions. The term 'suitable environment' refers to the combination of source habitat and risk factors that influence the probability of occupancy and demographic performance of a focal species. The five viability outcomes we used were:

Outcome A – Suitable environments are broadly distributed and of high abundance. The combination of distribution and abundance of environmental conditions provides opportunity for continuous or nearly continuous intra-specific interactions for the focal species. Focal species with this outcome are likely well-distributed throughout the planning area.

Outcome B - Suitable environments are broadly distributed and of high abundance, but there are gaps where suitable environments are absent or only present in low abundance. However, the disjunct areas of suitable environments are typically large enough and close enough to permit dispersal among subpopulations and to allow the species to potentially interact as a metapopulation. Species with this outcome are likely well-distributed throughout most of the planning area.

Outcome C – Suitable environments are distributed frequently as patches and/or exist at low abundance. Gaps where suitable environments are either absent or present in low abundance are large enough such that some subpopulations are isolated, limiting opportunity for intra-specific interactions. There is opportunity for subpopulations in most of the planning area to interact, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition, reduction in the species' range in the planning area may have resulted. Focal species with this outcome are likely well-distributed in only a portion of the planning area.

Outcome D – Suitable environments are frequently isolated and/or exist at very low abundance. While some of the subpopulations associated with these environments may be self-sustaining, there is limited opportunity for population interactions among many of the suitable environmental patches. For species for which this is not the historical condition, reduction in species' range in the planning area may have resulted. These species are likely not well-distributed in the planning area.

Outcome E – Suitable environments are highly isolated and exist at very low abundance, with little or no possibility of population interactions among suitable environmental patches, resulting in strong potential for extirpations within many of the patches, and little likelihood of recolonization of such patches. There has

likely been a reduction in the species' range from historical conditions, except for some rare, local endemics that may have persisted in this condition since the historical time period. Focal species with this outcome are not well-distributed throughout much of the planning area.

Model Evaluation

In order to evaluate the accuracy of the process and models to assess habitat conditions for focal species, a peer review is being conducted at three levels. First, a science team was convened (see Appendix B) to provide input on the process, including the use of habitat relationships data, clustering procedures, focal species selection and application of focal species assessment models. Second, species experts were consulted to help with the development of the species specific models. Their expertise is used to help determine which variables are most important to include in the models; what are the best ways to try to quantify the relationship between the variables and; what are the likely outcomes for the species detailed in the conditional probability tables. Finally, the process was tested on the three Northeast Washington planning Forests (NEWA). Once the models were built and some outputs were available, field biologists familiar with the habitat conditions in NEWA were convened and asked to provide feedback on the relative rankings of the HUC 5 watersheds to contribute to the conservation of each focal species.

Development of Conservation Strategies

Based on the outcomes of the BBNs, conservation strategies or measures can be developed to improve or maintain important habitats or to reduce risks to species. Conservation strategies or measures can be incorporated into plan components such as Desired Conditions or Objectives that will influence future ecological conditions. Plan components will often address both habitat and risk factors affecting species'-viability. Key elements of plan components could include (FSH 43.25):

- Managing for appropriate amount and distribution of source habitats
- Restoration of source habitat
- Managing natural and human disturbance factors (e.g. fire, roads)
- Managing invasive species
- Managing unique or rare habitats, or fine scale habitat features

Monitoring and Adaptive Management

A process was developed to determine priorities for focal species monitoring and the level of monitoring intensity that would be recommended. This process is based largely on the degree of risk that management options pose to the focal species. The process to prioritize focal species monitoring is based on: the viability outcome for the focal species; the degree to which the risk factors for the focal species are addressed in the management option(s); and the level of uncertainty associated with the understanding of the relationship between the risk factors and the sustainability of the focal species. A

framework, **Table 3**, can be used to help prioritize monitoring for focal species of conservation concern with the expectation that limited monitoring resources will be invested in the highest priority species.

TABLE 3: A framework to help guide monitoring priorities for focal species.

Priority for monitoring	**Viability High**	**Viability Low**	**Viability Uncertain**
Risk - Increase	Moderate Priority: Monitor Habitat and Risk Factors every 2 years	High Priority: Monitor Habitat, Risk Factors, Populations	High Priority: (Research)
Risk – No increase	Low Priority: Monitor Habitat and Risk Factors every 5 years	Moderate Priority: Monitor Habitat and Risk Factors every 2 years.	Low Priority: (Research)
Risk – Uncertain	Low Priority: (Research)	High Priority: (Research)	High Priority: (Research)

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Appendix A: Species of Conservation Concern and their Status, Family, Group, and Focal Species Identification for the Blue Mountains and Northeast Washington Plan revisions, Region 6 USFS

Family	Group	Common Name	Focal[1]	Planning Area[2]
Alpine/Boreal	Alpine	Gray-Crowned Rosy-Finch	f	
Alpine/Boreal	Boreal Forest	Spruce Grouse	F*	
		Boreal Owl	F*	
		Boreal Chickadee		N
		Pine Grosbeak		
		Pygmy Shrew		N
		Water Vole		
		Northern Bog Lemming	f	N
		Canada Lynx	F*	
		Moose		
Forest Mosaic	All Forest Communities	Northern Goshawk	F	
		Blue Grouse		
		Band-Tailed Pigeon		N
		Great Gray Owl		
		Long-Eared Owl		
Medium/Large Trees	All Forest Communities	Sharp-Shinned Hawk		
		Rufous Hummingbird		
		Williamson's Sapsucker		
		Hammond's Flycatcher		
		Cordilleran Flycatcher		
		Mountain Chickadee		
		Yellow-Rumped Warbler		B
		Cassin's Finch	F	
		Long-Legged Myotis		
		Silver-Haired Bat		
		Hoary Bat		
		Red-Tailed Chipmunk		N
		Northern Flying Squirrel		

Family	Group	Common Name	Focal[1]	Planning Area[2]
Medium/Large Trees	Cool/Moist Forest	Larch Mountain Salamander	f	N
		Spotted Owl	CS	
		Vaux's Swift		
		Pileated Woodpecker	F	
		Chestnut-Backed Chickadee		
		Brown Creeper		
		Winter Wren		
		Golden-Crowned Kinglet		
		Ruby-Crowned Kinglet		
		Townsend'S Warbler		B
		Varied Thrush		
		American Marten	F	
		Fisher		
		Caribou	CS	N
Medium/Large Trees	Dry Forest	Flammulated Owl		
		White-Headed Woodpecker	F	
		Purple Martin		N
		White-Breasted Nuthatch		
		Pygmy Nuthatch		
Open Forest	All Forest Communities	Rubber Boa		
		Sharptail Snake		N
		Calliope Hummingbird		B
		Dusky Flycatcher		B
		Western Bluebird	F	
		Chipping Sparrow		B
		Dark-Eyed Junco		B
		Purple Finch		
		Pine Siskin		
		California Myotis		
		Fringed Myotis	F	
		Long-Eared Myotis		
		Fox Sparrow	F	
		Lazuli Bunting		
Open Forest	Pine/Oak	California Mountain Kingsnake	f	N
		Acorn Woodpecker	f	N
		Western Gray Squirrel	f	N

Family	Group	Common Name	Focal[1]	Planning Area[2]
Open Forest	Post-Fire Habitat	American Kestrel		
		Lewis's Woodpecker	F	
		Three-Toed Woodpecker		
		Black-Backed Woodpecker	F	
		Olive-Sided Flycatcher		
		Western Wood-Pewee		
Upland Grassland	Upland Grassland	Upland Sandpiper	f	
Human Disturbance	Habitat Generalist	Peregrine Falcon	F	
		Gray Wolf	CS	
		Grizzly Bear	CS	
		Wolverine	F	
Woodland/Grass/ Shrub	Woodland/Grass/ Shrub	Pygmy Horned Lizard		
		Side-Blotched Lizard		
		Ringneck Snake		N
		Striped Whipsnake		
		Ferruginous Hawk		
		Golden Eagle	F	
		Prairie Falcon		
		Mourning Dove		B
		Common Nighthawk		B
		Common Poorwill		
		White-Throated Swift		
		Black-Billed Magpie		
		Rock Wren		B
		Lark Sparrow	F	
		Brewer's Blackbird		
		Western Small-Footed Myotis		
		Yuma Myotis		
		Spotted Bat		
		Pallid Bat	F	
Woodland/Grass/ Shrub	Juniper Woodland	Ash-Throated Flycatcher	F	
		Pinyon Jay		B
		Lesser Goldfinch		N
Woodland/Grass/ Shrub	Woodland/Shrub	Sagebrush Lizard		
		Night Snake		
		Gray Flycatcher		
		Loggerhead Shrike	F	
		Green-Tailed Towhee		
		Merriam's Shrew		

Family	Group	Common Name	Focal[1]	Planning Area[2]
Woodland/Grass/ Shrub	Shrub	Desert Horned Lizard		
		Greater Sage Grouse	F*	
		Sage Thrasher	F*	
		Brewer's Sparrow		
		Black-Throated Sparrow		
		Sage Sparrow		
		Pygmy Rabbit		
		Black-Tailed Jackrabbit		
Woodland/Grass/ Shrub	Grass/Shrub	Tiger Salamander	f	
		Sharp-Tailed Grouse		
		Long-Billed Curlew		
		Burrowing Owl		
		Horned Lark		
		Oregon Vesper Sparrow		
		Western Meadowlark		
		Preble'S Shrew		
		White-Tailed Jackrabbit		
		Sagebrush Vole		
		American Badger		
		Pronghorn		
		Mountain Goat		
		Rocky Mountain Bighorn Sheep	f	
		California Bighorn	f	
Woodland/Grass/ Shrub	Grassland	Northern Harrier	F*	
		Swainson's Hawk	F*	
		Short-Eared Owl		
		Grasshopper Sparrow	F*	
Chambers/Caves	Chambers/Caves	Townsend's Big-Eared Bat	F	
Riparian	Conifer Riparian	Inland Tailed Frog	F	
		Black Swift	f	
Riparian	Riparian/Large tree or snag/Open water	Wood Duck	F	
		Harlequin Duck	f	N
		Bufflehead		
		Common Goldeneye		
		Barrow's Goldeneye		
		Hooded Merganser		
		Common Merganser		
		Bald Eagle	F	

Family	Group	Common Name	Focal[1]	Planning Area[2]
Riparian	Shrubby/Deciduous Riparian	Mountain Quail		
		Yellow-Billed Cuckoo		B
		Western Screech-Owl		
		Black-Chinned Hummingbird		
		Broad-Tailed Hummingbird		B
		Red-Naped Sapsucker	F	
		Willow Flycatcher		
		Red-Eyed Vireo		
		Barn Swallow		B
		Black-Capped Chickadee		B
		Veery		
		Orange-Crowned Warbler		B
		Yellow Warbler		
		American Redstart		
		Northern Waterthrush		N
		Macgillivray's Warbler	F	
		Wilson's Warbler		
		Yellow-Breasted Chat		
		White-Crowned Sparrow		B
		American Goldfinch		B
		Water Shrew		
Riparian	Marsh with Adjacent Large Trees	Great Blue Heron		
		Great Egret		N
		Green Heron		N
		Black-Crowned Night-Heron	F	
Riparian	Pond/Small Lake/Backwater	Western Toad		
		Woodhouse's Toad	f	
		Cascades Frog	f	N
		Oregon Spotted Frog	F*	N
		Columbia Spotted Frog	F*	
		Northern Leopard Frog		
		Painted Turtle	f	
		Western Pond Turtle	f	
		Spotted Sandpiper		
Wetland	Marsh	American Bittern		
		Virginia Rail		
		Marsh Wren	F	
		Tricolored Blackbird		B
		Yellow-Headed Blackbird		

Family	Group	Common Name	Focal[1]	Planning Area[2]
Wetland	Marsh/Wet Meadow	Sandhill Crane		
		Black-Necked Stilt		N
		American Avocet		
		Greater Yellowlegs		
		Willet		
		Wilson's Snipe	F	
		Wilson's Phalarope		
		Bobolink		
Wetland	Marsh/Open Water	Common Loon		N
		Horned Grebe		
		Red-Necked Grebe		
		Eared Grebe	F	
		Western Grebe		N
		Clark's Grebe		N
		American White Pelican		
		Trumpeter Swan		N
		Blue-Winged Teal		
		Northern Shoveler		
		Northern Pintail		
		Green-Winged Teal		
		Canvasback		
		Redhead		
		Ring-Necked Duck		
		Greater Scaup		N
		Lesser Scaup		
		Ruddy Duck		
		Caspian Tern		N
		Forster's Tern		N
		Black Tern		N

Focal[1]:

F - focal for the group and in some cases these species are also acting as a focal species for other's in the family.

F* - indicates a choice of focal species depending on the individual planning unit. Primarily due to species distribution issues, planning areas may want to choose different species.

f - Because some species have very localized populations confined to specific habitats, these species will need to be analyzed locally where they occurs, and proposed management direction will apply only to that local area.

CS - Indicates a Conservation Strategy or Recovery Plan is in place, primarily by the US Fish and Wildlife Service.

[2]Planning Area: Blank=Northeast Washington and Blue Mountains; N=Northeast Washington only; B= Blue Mountains only

Appendix B: Contributors

R6 Terrestrial Species Assessment Workgroup

Kim Mellen-Team Co-Leader Regional Wildlife Ecologist USDA Forest Service Pacific Northwest Regional Office	Shawne Mohoric-Team Co-Leader Planning Biologist USDA Forest Service Pacific Northwest Regional Office
Barbara Wales Wildlife Biologist USDA Forest Service Pacific Northwest Research Station	William Gaines Forest Wildlife Ecologist USDA Forest Service Okanogan/Wenatchee National Forests
Lowell Suring Wildlife Ecologist USDA Forest Service Washington Office	Pam Corey Planning Biologist USDA Forest Service Pacific Northwest Regional Office
Robert Mason Planning Biologist USDA Forest Service Blue Mountains Planning Unit	James Begley Wildlife Biologist/GIS Specialist USDA Forest Service Okanogan/Wenatchee National Forests

R6 Species Viability Science Review Team

John Lehmkuhl Research Wildlife Biologist USDA Forest Service Pacific Northwest Research Station Wenatchee Forestry Sciences Lab	Michael Wisdom Research Wildlife Biologist USDA Forest Service Pacific Northwest Research Station LaGrande Forest and Rangeland Sciences Lab
Martin Raphael Senior Research Scientist USDA Forest Service Pacific Northwest Research Station Olympia Lab	Bruce Marcot Research Ecologist USDA Forest Service Pacific Northwest Research Station Portland Lab
Richard Holthausen National Wildlife Ecologist USDA Forest Service Washington Office	

Experts Consulted for Species Model Development

Name	Affiliation	Area of Expertise
Robert Altman	American Bird Conservancy	Avian Ecology
Peter Singleton	USDA Pacific Northwest Research Station	Carnivore Ecology Landscape Permeability
Robert Naney	USDA Forest Service, R6 Carnivore Species Leader	Carnivore Ecology and Management
Evelyn Bull	USDA Pacific Northwest Research Station	Woodpecker and Amphibian Ecology
Patricia Garvey-Darda	USDA Forest Service, Wenatchee National Forest	Amphibian Ecology

National Forest Biology Review Teams

Forest Reviewed	Name and Position	District/Agency
Okanogan	John Rohrer, District Wildlife Biologist	Methow Ranger District
Okanogan	Scott Fitkin, District Biologist	Washington Department of Fish and Wildlife
Okanogan	Jeremy Anderson, District Wildlife Biologist	Tonasket Ranger District
Okanogan	Robert Naney, Forest Wildlife Biologist	Okanogan National Forest
Colville	Chris Loggers, District Wildlife Biologist	Colville National Forest
Colville	James McGowan, Forest Wildlife Biologist	Colville National Forest
Wenatchee	Mallory Lenz, District Wildlife Biologist	Chelan Ranger District
Wenatchee	Ann Sprague, District Wildlife Biologist	Entiat Ranger District
Wenatchee	Don Youkey, District Wildlife Biologist	Wenatchee River Ranger District
Wenatchee	JoEllen Richards, District Wildlife Biologist	Cle Elum Ranger District
Wenatchee	Peter Forbes, District Wildlife Biologist	Naches Ranger District
Wenatchee	Beau Patterson, District Biologist	Washington Department of Fish and Wildlife